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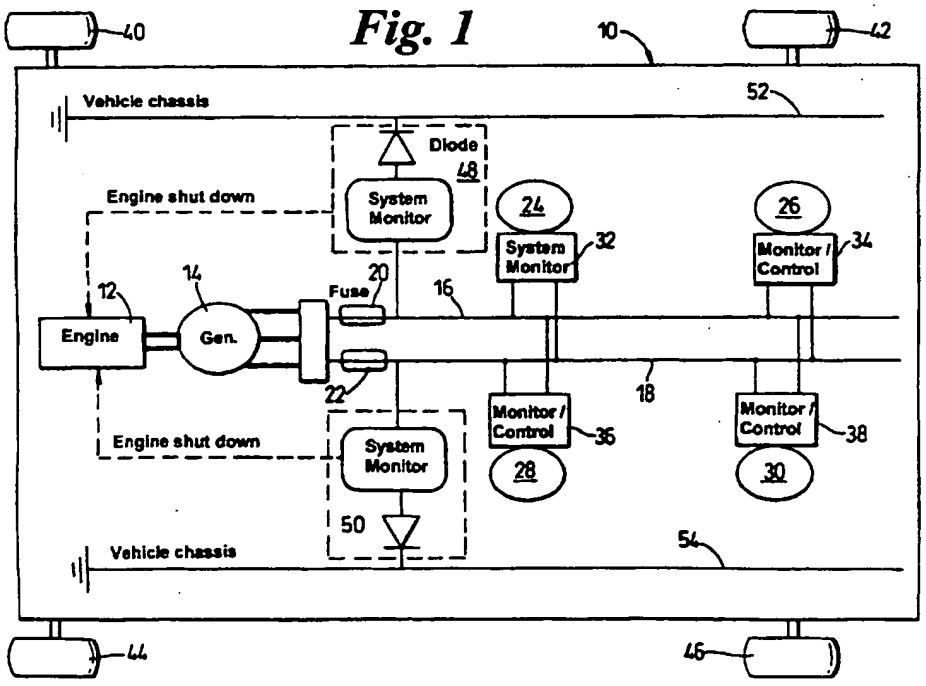
(54) Abstract Title
Vehicle monitoring system

(57) A series hybrid vehicle 10 has no traction batteries. Busbars 16, 18 are substantially encased in respective conductive housings, which are electrically linked to the vehicle chassis 52, 54 through a monitor circuit 48, 50. If there is a breakdown in isolation of a busbar 16, 18, the associated housing will become live and the monitor circuit 48, 50 will detect electrical communication between the housing and the chassis 52, 54. If a breakdown in isolation is detected, the monitor circuit 48, 52 causes the engine 12 to be shut down. Because drive from the engine 12 to the generator 14 is the only source of electrical tractive power and the engine 12 is shut down in the event of a breakdown in isolation of a busbar 16, 18, user safety is improved.

Fig. 1



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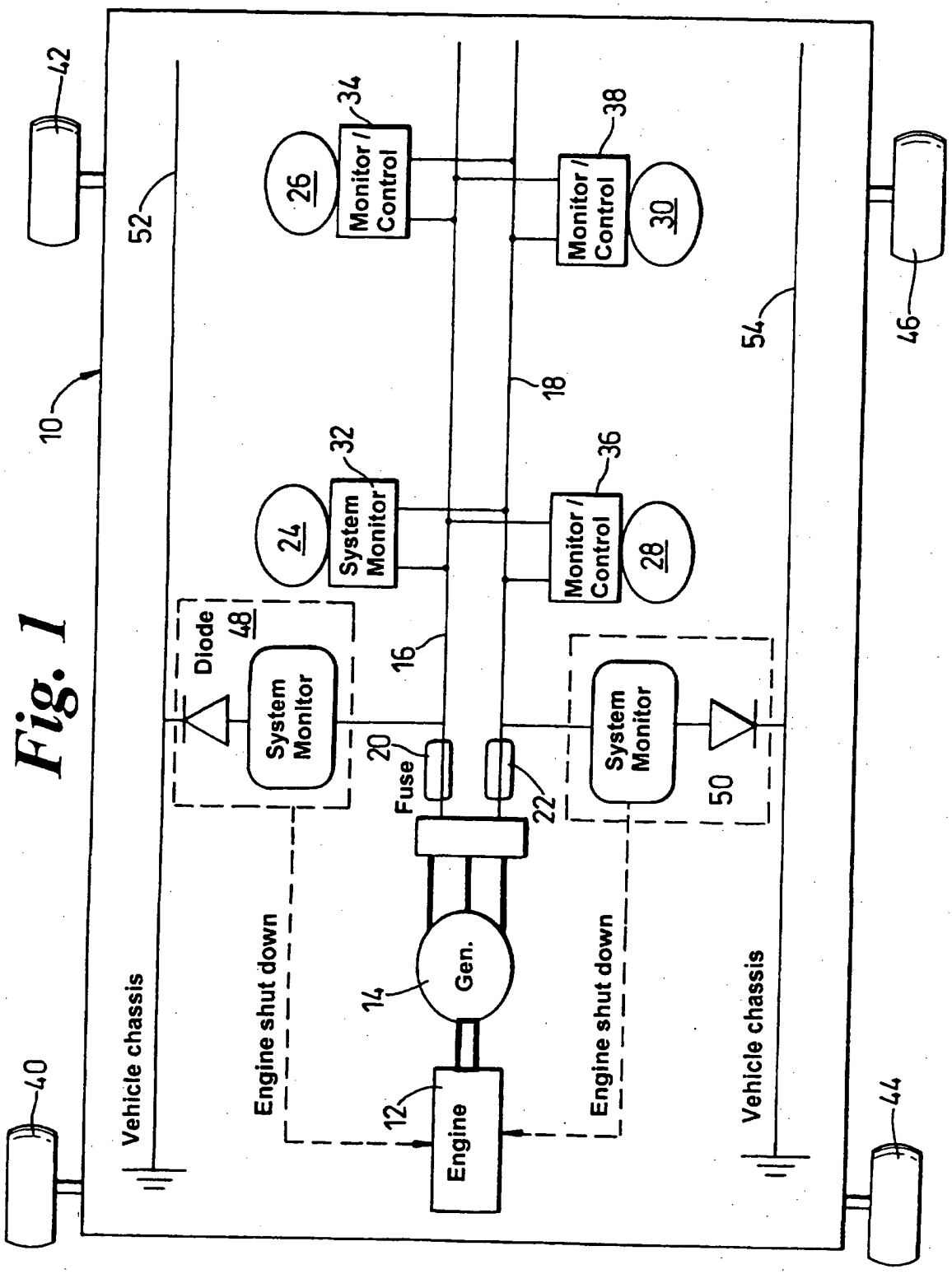
42
52
10
26
Monitor / Control
34
38
Monitor / Control
30
54
46
18
24
System Monitor
32
36
Monitor / Control
28
Diode
48
16
System Monitor
20
Fuse
22
System Monitor
50
Engine shut down
Gen.
14
Engine shut down
Vehicle chassis
12
Engine
Vehicle chassis
40
44

Fig. 1

A Vehicle

This invention relates to vehicles and in particular to a hybrid vehicle which includes an engine and a generator.

In a hybrid vehicle, there is a danger of electrocution if electrical isolation breaks down between certain live parts of the electrical system and the isolated parts such as the casing or the chassis. The live parts which pose the greatest danger to a user are those known in the art as phase conductors, which include the cables/busbars supplying traction motors and their associated terminal posts and connections.

It is an object of this invention to provide an improved vehicle.

Accordingly, the invention provides a vehicle comprising an engine which is arranged in use to drive a generator, the generator being arranged in use to supply, on at least one phase conductor, electrical power to at least one electrical machine, wherein the vehicle further comprises a control means which is arranged in use to monitor the isolation of at least part of said at least one phase conductor.

The control means may be arranged in use to shut down said engine if the engine is running and if said isolation falls below a predetermined level and may be arranged in use to inhibit the starting of said engine if the engine is not running and said isolation is determined to be below a predetermined level.

Said part of at least one phase conductor may be substantially encased in a conductive housing and the control means may comprise an electrical link between said conductive housing and a chassis member, wherein the control means is arranged to monitor the isolation of said at least part of said at least one phase

conductor by monitoring for electrical communication between the housing and the chassis member across said link.

Said link may comprise a resistive or capacitive link such that, if there is a reduction in isolation at one or more portions of said substantially encased part of said phase conductor, an electrical voltage is dropped across said link and thereby provides a signal to the control means, which signal is indicative of said reduction in isolation.

The degree of breakdown in said isolation at which the control means shuts the engine down may be pre-set in said control means. Such pre-setting may be by programming and may be varied in use.

The control means may be arranged to shut down said engine by interrupting at least one of a fuel supply or an ignition circuit.

The vehicle may comprise a series hybrid vehicle in which the generator comprises the only source of electrical tractive power.

The invention will now be described by way of example with reference to the accompanying drawing, in which:

Figure 1 is a schematic diagram of a vehicle according to the invention.

Referring to the figure, a series hybrid vehicle 10 comprises an engine 12 which drives a generator 14. The generator supplies a pair of phase conductors in the form of a positive busbar 16 and a negative busbar 18 though a respective fused link 20, 22.

A separate electrical machine in the form of a traction motor 24, 26, 28, 30 and an associated motor control unit 32, 34, 36, 38 is provided for each wheel 40, 42, 44, 46. The control units 32, 34, 36, 38 each draw electrical power off the busbars 16, 18 for their respective motors 24, 26, 28, 30.

Each busbar 16, 18 is substantially encased in an associated conductive housing (not shown). The housing is only accessible using a specially configured access tool and is interlocked with the engine 12 such that the engine 12 cannot run if the sealing of one or more of the busbar housings is/are compromised.

The vehicle 10 further comprises control means in the form of a monitor circuit 48, 50 associated with each busbar 16, 18. Each monitor circuit 48, 50 links the conductive housing associated with its busbar 16, 18 with a vehicle chassis member 52, 54 though a very high impedance.

If the isolation of the busbars 16, 18 fails along any portion which is encased in the conductive housing, then the housing becomes live in proportion to the breakdown in isolation. Thus if the isolation of a busbar 16, 18 from the chassis 52, 54 fails at a point which is electrically downstream of the generator 14 and within the part of the busbar 16, 18 which is encased in the housing, a small current will flow through the high impedance link and will be detected by the associated monitor circuit 48, 50.

The detection of the current can be by monitoring for a voltage drop across the resistance or, as the current will be small due to the high impedance, it may be found possible to use direct current monitoring. It would be possible to use a different impedance to the resistance, such as for example a capacitor. If a capacitor were to be used, the monitor circuit 48, 50 would assess the state of

isolation by monitoring for a voltage rise across the capacitor if it was being charged up.

Electrical communication which may take place between the housing and the chassis member 52, 54 across the high impedance link will be indicative of a breakdown in isolation of the associated busbar 16, 18 and the monitor circuit 48, 50 which detects the fault will cause the engine 12 to be shut down.

The level of isolation necessary to prevent engine shut down is set by pre-setting the monitor circuit 48, 50 at a level appropriate for the use to which the vehicle 10 will be put. For example, an off-road vehicle might be permitted to suffer a greater reduction in isolation than a road vehicle so as to reduce the likelihood of false alarms when it goes wading.

The monitor circuits 48, 50 can use any convenient way to shut down the engine 12, such as interrupting a fuel supply and/or cutting out an ignition circuit.

The monitor circuits 48, 50 are also arranged to prevent starting of the engine 12 if it is not running and the isolation is found, e.g. on power-up of the system, to be below the required level for safe operation.

The vehicle 10 includes no traction batteries and so the generator 14 is the only source of tractive power for the motors 24, 26, 28, 30. This means that, once drive from the engine 12 to the generator 14 is removed, the busbars 16, 18 are without power and the safety of a user is increased.

CLAIMS

1. A vehicle comprising an engine which is arranged in use to drive a generator, the generator being arranged in use to supply, on at least one phase conductor, electrical power to at least one electrical machine, wherein the vehicle further comprises a control means which is arranged in use to monitor the isolation of at least part of said at least one phase conductor.

2. A vehicle according to Claim 1, wherein the control means is arranged in use to shut down said engine if the engine is running and if said isolation falls below a predetermined level.

3. A vehicle according to Claim 1 or Claim 2, wherein the control means is arranged in use to inhibit the starting of said engine if the engine is not running and said isolation is determined to be below a predetermined level.

4. A vehicle according to any preceding claim, said part of at least one phase conductor being substantially encased in a conductive housing and the control means comprising an electrical link between said conductive housing and a chassis member, wherein the control means is arranged to monitor the isolation of said at least part of said at least one phase conductor by monitoring for electrical communication between the housing and the chassis member across said link.

5. A vehicle according to Claim 4, wherein said link comprises a resistive or capacitive link such that, if there is a reduction in isolation at one or more portions of said substantially encased part of said phase conductor, an electrical voltage is dropped across said link and thereby provides a signal to the control means, which signal is indicative of said reduction in isolation.

6. A vehicle according to any preceding claim, wherein the degree of breakdown in said isolation at which the control means shuts the engine down can be pre-set in said control means.

7. A vehicle according to any preceding claim, wherein the control means is arranged to shut down said engine by interrupting at least one of a fuel supply or an ignition circuit.

8. A vehicle according to any preceding claim, the vehicle comprising a series hybrid vehicle in which the generator comprises the only source of electrical tractive power.

9. A vehicle substantially as described herein with reference to the accompanying drawing.

The Patent Office

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Application No: GB 9901102.5 **Examiner:** David Brunt
Claims searched: 1-9 **Date of search:** 10 May 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): B60L (3/04, 11/02, 11/04, 11/06, 11/08, 11/10, 11/12), G01R (31/00), H02H (3/14, 3/16, 11/00)

Other: Online: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WO 95/34824 A1 (WESTINGHOUSE) see p.3 ll.12-21	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.